

The Weight of Cicada Killer Wasps, *Sphecius speciosus*, and the Weight of their Prey

Norman Lin

1487 E. 37th St., Brooklyn, N.Y. 11234.

ABSTRACT

Contrary to the distinct weights and lengths between male and female cocoons previously found by other workers, a slight overlap in the weights of adult cicada killers was found in the present study. Wasps preyed on 3 species of *Tibicen*. Two of these, *T. resh* and *T. figurata*, have never previously been reported as prey. Of the 10 specimens of prey, 8 were the larger *T. resh*. As reported previously by several workers, female cicada prey considerably outnumbered males taken. Six *T. resh* were female, 2 were male. The remaining *T. figurata* and *T. lyricen* were both females. Two of 5 cicadas weighed more than twice as much as the wasps carrying them, and the remaining 3 cicadas weighed less than twice as much as the wasps. Previous claims of cicadas weighing 4 to 6 times as much as the wasps carrying them appear to be greatly exaggerated.

Female cicada killer wasp eggs are typically provisioned with 2 cicadas and male eggs with 1 cicada (Dow 1942). Dow found that cocoons were of 2 different classes in respect to size. Measurements of their lengths and weights showed that male and female cocoons were quite distinct and separated by intervals of 5.0 mm and 1.0 g. According to Dambach and Good (1943), 47 cells containing small or medium-sized cocoons were found to be provisioned with but 1 cicada. In the same set of observations, cells containing large cocoons were found to have been provisioned with 2 cicadas in 19 cells and with 3 cicadas in 5 cells. Only 2 large cocoons were found with single cicadas, and each of these had a large female, *Tibicen lyricen*. Dow (1942) excavated 42 cells, 3 of which contained 3 cicadas; none of the 3 contained cocoons. Of the 18 cocoons Dow reared to adults, 2 of the adult males came from cells containing 2 cicadas each. Both contained a male and a female of the lighter *Tibicen canicularis*. Of the 6 adult females reared, all came from cells which contained 2 female cicadas, 2 of them 2 females of *T. lyricen*, 2 a *T. canicularis* and a *T. lyricen*, and 2 *T. canicularis*. Dow

reared 12 adult males and 6 adult females and found the weight of the males to range from 0.13 g to 0.44 g and the weight of the females to range from 0.61 g to 1.09 g.

The present study will show that although female wasps tend to be considerably larger and heavier than male wasps, this is occasionally not the case. This was first suspected as a result of years of data gathering from Brooklyn populations in which the sex of wasps could be determined from their emergence holes. Males came from holes 5 to 10 mm, 5- and 6-mm holes were rare, and females came from emergence holes 12 mm to 19 mm, 17- to 19-mm holes being quite rare. However, roughly one-half of 11 mm emergence holes were made by males, and roughly one-half were made by females. A further assumption supported by numerous observations of emerging wasps is the width of the emergence hole provides a good index of the width and size of the wasp. Dambach and Good (1943) found the average length of 135 cocoons was 32 mm, and the average width at the widest point was 11 mm. The smallest cocoon found measured 21 mm in length and 7 mm in diameter. The largest

Table 1.—Weight of the Various Male and Female Cicada Killers in Present Study.

		Adult Males																	Adult Females						
No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22	23
Weight (g)		0.30	0.41	0.46	0.47	0.50	0.51	0.54	0.55	0.57	0.62	0.64	0.64	0.64	0.69	0.69	0.70	0.71		1.41	1.50	1.52	1.57	1.58	1.74
No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	21	22	23
Weight (g)		0.61	0.82	0.92	1.06	1.12	1.18	1.18	1.20	1.20	1.21	1.22	1.24	1.25	1.28	1.37	1.38	1.40		1.41	1.50	1.52	1.57	1.58	1.74

specimen found was 47 mm in length and 16 mm in diameter. Dambach and Good's (1943) cocoon widths are almost identical with adult emergence hole widths used by the observer in sexing the Brooklyn populations. There is little doubt that the relationship is not one of chance. The mean width of 111 emergence holes in population 1 in Brooklyn in 1958 was 10 mm. The smallest hole measured 6 mm in diameter. The largest hole was 16 mm in diameter. These figures closely approximate Dambach and Good's (1943) figures for cocoon widths.

Dow (1942) obtained his cicada killer cocoons from Berkley, Massachusetts. The following study of a cicada killer population was made on a sandy tract surrounding the main building of the U. S. Department of Agriculture, Southern Forest Experiment Station in Pineville, Louisiana in July, August, and September of 1977. A total of 40 adult *Sphecius*, 17 males and 23 females, was captured and weighed while alive. A total of 10 paralyzed cicadas was taken from females and weighed. Three live cicadas from the area were weighed which were not captured by wasps. The Pineville cicadas belonged to 3 species. In order of decreasing size, they were *Tibicen resh*, *T. figurata*, and *T. lyricen*. There were 10 *T. resh* (8 ♀♀ and 2 ♂♂), 2 *T. figurata* (1 ♀ and 1 ♂), and 1 ♀ *T. lyricen*. The use of *T. resh* and *T. figurata* as prey by *Sphecius* had not been previously reported. Assuming that the 3 prey species and sexes are equally easy to capture, the relative number of the different cicadas caught might reflect the relative abundance of the different species and sexes in the area, or the wasps might have been selecting their prey species as well as the sex of their prey. This latter hypothesis appears to be true of *Sphecius* in general (Lin, in press).

In 5 of the previous cases, the weight of the female wasp as well as the weight of her prey was obtained.

In 4 cases, the female was weighed immediately after her emergence, having

Table 2.—Weight of Living Cicada Prey (1) Taken from *Sphecius* and (2) Captured by Observer.

No.	1	2	3*	4	5	6	7*	8	9	10	11	12	13*
Wt. of Cicada (g)	1.61	1.79	1.86	2.11	2.24	2.35	2.59	2.66	2.70	2.70	2.78	2.81	2.84
Species	T.l.	T.f.	T.f.	T.r.	T.r.	T.r.	T.r.	T.r.	T.r.	T.r.	T.r.	T.r.	T.r.
Sex	♀	♀	♂	♂	♀	♀	♀	♀	♀	♂	♀	♀	♀

* Captured by observer.

T.l. = *T. lyricen lyricen*.

T.f. = *T. figurata*.

T.r. = *T. resh*.

been caught while still in copula. In 2 of these cases, the male in copula with the female was also subsequently weighed. All wasps and cicadas were weighed on a Mettler H64 scale which is accurate to ± 0.1 mg.

The weight of adult males ranged from .30 g to .71 g with a mean of .57 g. The weight of adult females ranged from .61 g to 1.58 g with a mean of 1.26 g. See Table 1 for the weights of the various males and females in the present study. The mean weight of Dow's males was .35 g and considerably less than the mean weight of males in the following study. The mean weight of Dow's females was .82 g and also considerably less than the mean weight of females of the study. Only 2 of the 17 males in the present study were lighter than 1 or more males in Dow's sample.

Four females of the total of 23 in the following study were lighter than 1 or more females in Dow's sample.

The lightest female in the present study (.61 g) was lighter than 8 of the 17 males in the present sample (see Table 1). This female also weighed the same as Dow's lightest female.

The range in weight of the 10 prey specimens taken from female wasps was 1.61 g to 2.81 g \bar{X} 2.33 g. Table 2 gives the weight and sex of these specimens including the three not captured by *Sphecius*. Dow (1942) did not have any freshly paralyzed prey, so he captured a few cicadas of the 2 species (*Tibicen canicularis* and *T. lyricen*) used by *Sphecius* in his sample and took the weight of these specimens as estimates of the weight of the actual prey. The

male *T. canicularis* weighed .93 g, and the female 1.12 g. The male *T. lyricen* weighed 1.39 g and the female 1.94 g. All of the specimens in the present study weighed more than the male and female of *T. canicularis* and the male of *T. lyricen*. Only 2 of the 10 specimens weighed less than Dow's female *T. lyricen* (see Table 2). The heavier wasps in the present study might be a consequence of the heavier prey species used by the Pineville wasps. Dow (1942), however, presents several reasons why his weight data should be subject to criticism. The most serious of these is that his specimens were weighed both alive and dead in varying periods of time after reaching full development.

Table 3 gives the weight of the 5 female *Sphecius* and the weight of each female's prey. Though the sample is small, there is no correlation between the weight of the female *Sphecius* and the weight of her prey. The lightest of the 5 females carried the heaviest prey specimen. Balduf (1941) claimed to have weighed freshly killed wasps and their cicada prey and found the cicadas to weigh 4–6 times as much as the wasps. Table 3 reveals that 2 of the 5 cicadas weighed more than twice as much as the wasps but con-

Table 3.—Weight of Female *Sphecius* and Weight of Her Prey.

No.	1	2	3	4	5
Wt. of Cicada (g)	2.66	2.70	2.70	2.78	2.81
Wt. of Wasp (g)	1.37	1.20	1.38	1.58	1.06
Weight ratio	1.94	2.25	1.95	1.76	2.65

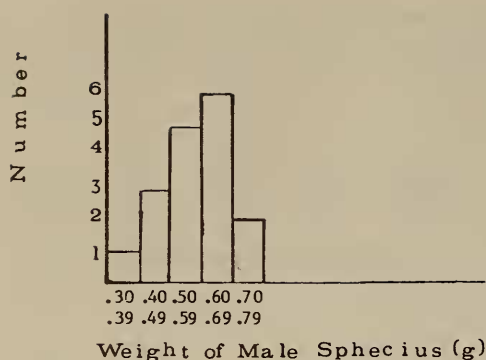


Fig. 1. Weight of male *Sphecius* in grams.

siderably less than 3 times as much, and the remaining 3 cicadas weighed less than twice as much as the wasps. Only by comparing the lightest of the female wasps (.61 g) and the heaviest cicada captured by *Sphecius* (2.81 g) do we come to a figure approximating Balduf's, where the cicada weighed more than 4 times the wasp. However, we are seemingly dealing with a rare extreme because this female weighed less than 8 males in the sample of 17. In the case of the second lightest female (.82 g), the cicada weighed less than 4 times the wasp (2.81 g). Dow's data support a similar conclusion; his heaviest cicada (1.94 g) weighs 3 times his 2 lightest female wasps (.61 g, .63 g) and 2 times his third and fourth lightest female and less than 2 times his 2 heaviest wasps. The Pineville cicadas are all larger species than the Brooklyn cicadas which were *T. linnei*, and sometimes these Brooklyn females abandoned the cicadas in unsuccessful attempts to climb objects tall enough to take flight from and

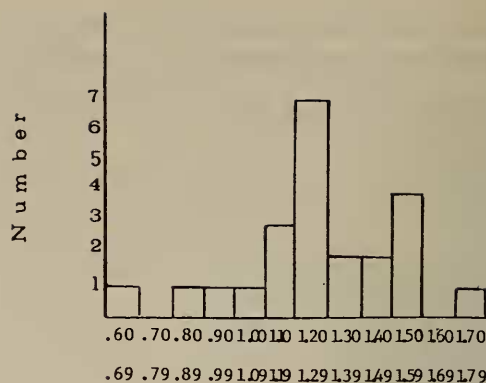
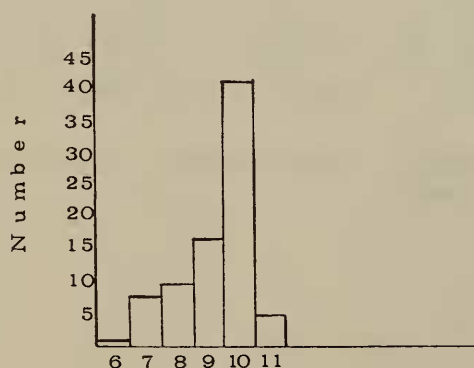


Fig. 3. Weight of female *Sphecius* in grams.

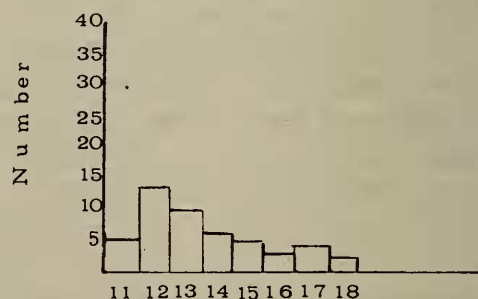
reach the nest. Thus, cicadas typically double or less than double the weight of wasps were too heavy for some wasps to return with. Balduf's (1941) claims of prey weighing 4–6 times as much as the wasps carrying them seems to be greatly exaggerated.

The weight of 4 newly emerged females caught in copula was .61 g, .82 g, 1.21 g, and 1.28 g. The males involved in the second and third cases were also weighed, being .69 g and .54 g. In the copulatory flight, the female pulls the male behind her (Lin, 1966, 1967). The data for females indicate there is no large change of weight between emergence and later in the season. The 2 lightest females were caught at emergence (.61 g, .82 g). However, 2 relatively heavy females were also caught on emergence—the 10th heaviest female (1.21 g) and the 14th heaviest female (1.29 g) of the total of 23 females (Table 1). After emergence and copulation, females leave the arenesting society for approximately 8 days.



Width of Male Emergence Holes (mm)

Fig. 2. Width of male emergence holes in mm.



Width of Female Emergence Holes (mm)

Fig. 4. Width of female emergence holes in mm.

The remaining females in Table 1 were probably at least 8 days old or older.

Emergence holes and their widths were marked, counted, and measured from July 12 to July 31. These holes were not counted daily but sporadically on 9 different dates. Most holes were probably accounted for, since the soil was hard clay and relatively inaccessible to destructive forces. Emergence continued after July 31 and up to August 25, when Dr. John Moser saw a copulating pair; thus, the female had just emerged. Males live a maximum of about 15 days and females about 30 to 33 days (Lin in Evans, 1966). I suspect I counted and measured one-half to three quarters of all the emergence holes in the population. Wasps were weighed from July 15 to September 7. A very large proportion of weighed wasps probably had their emergence holes measured, especially since after mating, the newly emerged female leaves the arena-nesting society for about 8 days, and males spend long periods in their territories, approximately after 5 days following their emergence. In Fig. 1, male-weight categories were plotted by number of wasps. Weight and width of wasps are likely to be correlated. Thus, in Fig. 2, male emergence holes (6 to 10 mm and one-half 11 mm holes—because about one-half of 11 mm holes produce males) were plotted as to number, and there is a very similar pattern between numbers in male-weight categories and size categories of male emergence holes. The same was done for

females in Figs. 3 and 4. In the females, there is no distinct pattern.

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